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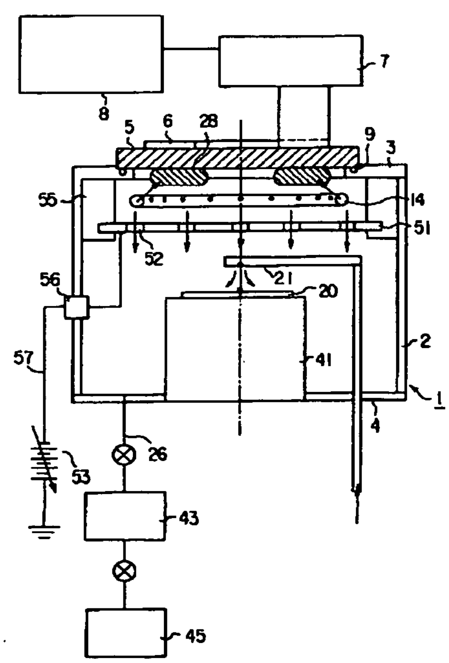
(54)【発明の名称】　誘導結合型プラズマＣＶＤ装置

(57)【要約】

【課題】　装置コスト及びランニングコストの増大を招くことなく、良質のＣＶＤ薄膜を効率良く形成することが可能な誘導結合型プラズマＣＶＤ装置を提供すること。

【解決手段】　本発明の誘導結合型プラズマＣＶＤ装置は、排気手段４３を備えた反応室１と；反応室１の内部で被処理材２０を支持するステージ４１と；ステージ４１に対向する様に設けられた誘電体窓５と；誘電体窓５に近接して反応室の外部に配置されたリング状アンテナ６と；リング状アンテナ６に高周波電力を供給する第一の電源８と；誘電体窓５に近接して反応室１の内部に配置された酸素ガス供給ノズル１４と；ステージ４１の被処理材２０を支持する面に近接して配置された反応ガス供給ノズル２１と；酸素ガス供給ノズル１４と反応ガス供給ノズル２１との間に配置されたグリッド状の電極５１と；を備える。



【特許請求の範囲】

【請求項１】　反応室と、
反応室の内部を排気する排気手段と、
反応室の内部に配置され、被処理材を支持するステージと、
前記ステージに対向する様に設けられ、反応室を構成する界壁の一部なす誘電体窓と、
前記誘電体窓に近接して反応室の外部に配置されたアンテナと、
前記アンテナに高周波電力を供給する第一の電源と、
前記誘電体窓に近接して反応室の内部に配置され、反応室の内部に酸素ガスを供給する酸素ガス供給ノズルと、
前記ステージの被処理材を支持する面に近接して配置され、反応室の内部に反応ガスを供給する反応ガス供給ノズルと、
を備えた誘導結合型プラズマＣＶＤ装置において、
前記酸素ガス供給ノズルと前記反応ガス供給ノズルとの間に、グリッド状の電極を配置するとともに、このグリッド状の電極に電圧を供給する第二の電源を設けたことを特徴とする誘導結合型プラズマＣＶＤ装置。

【請求項２】　前記グリッド状の電極を石英で被覆するとともに、前記第二の電源を高周波電源としたことを特徴とする請求項１に記載の誘導結合型プラズマＣＶＤ装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、誘導結合型プラズマＣＶＤ装置に係り、特に、酸素ガスプラズマを用いて反応ガスを分解して、試料上にSiO_2等の薄膜を堆積させる誘導結合型プラズマＣＶＤ装置に関するものである。

【０００２】

【従来の技術】図２に、従来の誘導結合型プラズマＣＶＤ装置（Inductive Coupled Plasma CVD System ）の構造の一例を示す。反応室１は、側壁２、上蓋３及び下蓋４で構成されている。反応室１内には、側壁２の内周に沿って石英製の円環２７が配置されている。上蓋３の上面には石英製の誘電体窓５が設けられ、誘電体窓５の上には銅製でリング状のアンテナ６が設置されている。アンテナ６は、マッチングボックス７を介して高周波電源８に接続されている。

【０００３】上蓋３には酸素ガスを反応室１内に供給する酸素ガス供給ノズル１４が設けられ、この酸素ガス供給ノズル１４に酸素ガス供給用の配管１３が接続されている。酸素ガスは、ボンベ３１、ボールバルブ３０、流量調整弁２９、配管１３及び酸素ガス供給ノズル１４を介して、反応室１内の誘電体窓５の下側付近に供給される。

【０００４】一方、被処理材であるウエハ２０は、下蓋４に支持されたヒータ１９の上にセットされる。ヒータ１９の周囲には、数組の反射板１８が配置されている。ヒータ１９の上方には、石英製でリング状の反応ガス供給ノズル２１が設けられており、反応ガスを当該リングの内側へ向けて噴出する様になっている。この反応ガス供給ノズル２１には、下蓋４を貫通する配管２４が接続され、配管２４を介して反応室の外部から反応ガスが供給される。また、下蓋４には排気管２６が接続されており、反応室１の内部の真空排気を行う。

【０００５】次に、この誘導結合型プラズマＣＶＤ装置の運転の概要を、ウエハ２０上にSiO_2薄膜を形成する場合を例にとって、説明する。先ず、ウエハ２０を反応室１内のヒータ１９の上にセットした後、排気管２６を介して反応室１内を、真空ポンプ（図示せず）によって、例えば、10^{-5} Torr まで真空排気する。

【０００６】ヒータ１９に電力を供給して、所定の温度まで（３００～５００℃程度）まで昇温する。昇温後、反応室１の内部に酸素ガス供給ノズル１４を介して酸素ガスを供給するとともに、反応ガスとしてジクロールシランガス（SiH_2Cl_2）を反応ガス供給ノズル２１を介して酸素ガスに対して所定の割合で供給する。

【０００７】反応室１内の圧力を所定圧力に調節した後、マッチングボックス７を介して、アンテナ６に高周波電力を供給する。これによって、反応室１内に供給された酸素ガスが励起されて、誘電体窓５の下側に酸素ガスプラズマ２８が形成される。ウエハ２０の表面近傍に供給されたジクロールシランガスは、酸素ガスプラズマ２８中から供給される活性酸素によって分解されて、その結果、ウエハ２０の上にSiO_2の薄膜が堆積される。

【０００８】薄膜の形成が完了した後、高周波電源８を切り、酸素ガス、ジクロールシランガスの供給を停止し、これらのガスを、反応室１内から排気管２６を介して排気して、薄膜の形成プロセスが終了する。

【０００９】（従来の技術の問題点）上記の様な構造を備えた従来の誘導結合型プラズマＣＶＤ装置に関しては、下記の様な問題点がある。

【００１０】ａ．良質のSiO_2薄膜を得るには、プラズマ中で生成された活性酸素が充分な量でウエハ表面に供給されることが必要である。ところが、活性酸素の寿命が非常に短いので、プラズマとウエハとの距離をできるだけ近付けなければならない。なお、活性酸素の供給量が少ない場合、良質のSiO_2薄膜が得られず、クラック発生等の要因となる。

【００１１】ｂ．ジクロールシランを、ウエハの表面近傍から供給しているので、プラズマとウエハとの間隔を近付けるに従って、ジクロールシランの供給ノズルとプラズマとの距離も縮まる。この様な状態で薄膜の形成を行うと、プラズマ中で同時に形成される高エネルギー電子によってジクロールシランも分解され、それによって気相中でＳｉ微粒子が形成されるので、やはり良質の薄

膜が得られない。

【0012】c．以上の様なジクロールシランの過分解を抑制するために、プラズマ中の電子温度の低下を図るべく所定の周波数で高周波電力のON／OFFを行うと、電子温度が低下し、これに伴って酸素ガスの活性化も抑制される結果、反って膜質が劣化してしまう。

【0013】d．また、薄膜の堆積速度を増大するするために、ジクロールシランの流量を増大すると活性酸素量が不足する。また、これを改善すべく供給する酸素ガスの流量を増大すると、排気装置の容量を増大する必要がある。しかし、排気装置の容量を大きくすると、設備コストの高騰を招く。

【0014】

【発明が解決しようとする課題】以上の様な問題に鑑み、本発明の課題は、設備コスト及びランニングコストの増大を招くことなく、良質のCVD薄膜を効率良く形成することが可能な誘導結合型プラズマCVD装置を提供することにある。

【0015】

【課題を解決するための手段】本発明の誘導結合型プラズマCVD装置は、反応室と、反応室の内部を排気する排気手段と、反応室の内部に配置され、被処理材を支持するステージと、前記ステージに対向する様に設けられ、反応室を構成する界壁の一部なす誘電体窓と、前記誘電体窓に近接して反応室の外部に配置されたアンテナと、前記アンテナに高周波電力を供給する第一の電源と、前記誘電体窓に近接して反応室の内部に配置され、反応室の内部に酸素ガスを供給する酸素ガス供給ノズルと、前記ステージの被処理材を支持する面に近接して配置され、反応室の内部に反応ガスを供給する反応ガス供給ノズルと、を備えた誘導結合型プラズマCVD装置において、前記酸素ガス供給ノズルと前記反応ガス供給ノズルとの間に、グリッド状の電極を配置するとともに、このグリッド状の電極に電圧を供給する第二の電源を設けたことを特徴とする。

【0016】なお、上記のグリッド状の電極とは、例えば、多数の貫通孔が設けられた金属板、あるいは金属製の格子などの様に、気体が容易に透過することが可能な形状の電極を意味する。

【0017】また、前記グリッド状の電極に起因する反応室内のコンタミネーションが問題となる場合には、この電極を石英硝子等で被覆する。但し、その場合には、前記第二の電源を高周波電源として、前記グリッド状の電極に高周波電圧を供給する必要がある。

【0018】以下に、本発明による誘導結合型プラズマCVD装置の作用を説明する。酸素ガス供給ノズルから誘電体窓の近傍に供給された酸素ガスは、アンテナにより形成される高周波電場によって励起されてプラズマ状態となる。一方、反応ガス供給ノズルからステージ上の被処理材の表面の近傍に供給された反応ガスは、酸素ガスプラズマ中で生成され被処理材の表面の近傍に到達した活性酸素によって分解され、その結果、被処理材の表面に薄膜の堆積が起こる。

【0019】本発明による誘導結合型プラズマCVD装置では、上記の様な酸素ガスプラズマ生成領域と、反応ガスが供給される被処理材の表面近傍領域との間にグリッド状の電極を配置して、これら二つの領域の間を分離している。

【0020】薄膜形成のプロセス中に、前記電極に所定の電圧を印加することによって、反応ガスの過分解の要因となる高エネルギー電子が、酸素ガスプラズマ生成領域から被処理材の表面近傍領域に侵入しない様にしている。即ち、前記電極の電位をプラズマ電位と等しくすれば、プラズマ生成領域と被処理材の表面近傍領域との間を流れる電流（即ち、イオン及び電子の流れ）がなくなる。また、プラズマ電位に較べて前記電極の電位を小さくすれば、高エネルギー電子がプラズマ生成領域から被処理材の表面近傍領域へ侵入することが防止され、反応ガスの過分解が抑制される。

【0021】

【発明の実施の形態】図1に、本発明に基く誘導結合型プラズマCVD装置の構造の一例を示す。反応室1は、側壁2、上蓋3及び下蓋4で構成されている。上蓋3の上面には、石英製の誘電体窓5が設けられている。誘電体窓5の上には、銅製のリング状アンテナ6が設置されており、リング状アンテナ6は、マッチングボックス7を介して高周波電源8（第一の電源）に接続されている。誘電体窓5と上蓋3との間には、Oリング9が配置されており、反応室1の内部をシールしている。

【0022】反応室1の下蓋4の上にはステージ41が設置されており、ステージ41の上部にウエハ20（被処理材）がセットされる。なお、この例では、ウエハ20のサイズは6インチ（150mmφ）である。

【0023】下蓋4には排気管26が接続されており、排気管26にはターボ分子ポンプ43が接続され、その排気側はロータリーポンプ45に接続されている。反応室1の上蓋3の下側には、酸素ガスを誘電体窓5の下面に向けて供給するリング状の酸素ガス供給ノズル14が配置されている。この酸素ガス供給ノズル14は、反応室1の外部に配置された酸素ボンベ（図示せず）に接続されている。なお、誘電体窓5の有効径は300mmであり、誘電体窓5の下面から酸素ガス供給ノズル14までの距離は15mmである。

【0024】ステージ41の上方には、ジクロールシランガス（反応ガス）をウエハ20の表面付近に供給する反応ガス供給ノズル21が配置され、反応ガス供給ノズル21は、反応室1の外部に配置された反応ガス供給源（図示せず）に接続されている。反応ガス供給ノズル21は、図1に示す様に、ウエハ20の中心部の上方に位置し、ジクロールシランガスを下方のウエハ20表面に

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向けて噴出する様になっている。なお、ウエハ２０から反応ガス供給ノズル２１までの距離は２５ｍｍである。

【００２５】更に、酸素ガス供給ノズル１４と反応ガス供給ノズル２１との間には、リング状の酸素ガス供給ノズル１４の下側を完全に遮蔽する様に、グリッド状の電極５１が配置されている。この電極５１は、厚さ１ｍｍ、直径３２０ｍｍの銅製の薄板であり、この電極５１には直径３ｍｍの貫通孔５２が、縦横それぞれ６ｍｍピッチで配列されている。また、電極５１から酸素ガス供給ノズル１４までの距離は１０ｍｍ、電極５１から反応ガス供給ノズル２１までの距離は１８ｍｍである。

【００２６】反応室の外部には、電極５１に対して電圧を供給する電源５３（第二の電源）が設けられている。なお、電極５１は絶縁碍子５５を用いて反応室１に取付けられており、電源５３と電極５１を接続する配線５７が反応室１を貫通する部分には、絶縁碍子５６が設けられている。

【００２７】次に、この誘導結合型プラズマＣＶＤ装置の運転について、ウエハ２０の表面にSiO_2の薄膜を形成する場合を例にとって説明する。ウエハ２０を反応室１内のステージ４１の上にセットした後、反応室１の内部を、排気管２６を介してターボ分子ポンプ４３により、10^{-6} Torr まで排気する。

【００２８】酸素ガス供給ノズル１４から、０．５ＳＬＭの酸素ガスを反応室１の内部に供給する。反応ガス供給ノズル２１から、０．１ＳＬＭのジクロールシランガス（SiH_2Cl_2）を供給する。

【００２９】反応室１内の圧力を10^{-2} Torr に調節した後、電極５１に－３０Ｖの電圧を印加する。高周波電源８からマッチングボックス７を介してリング状アンテナ６に３ＫＷの高周波電力を供給する。以上によって、酸素ガスが励起されて誘電体窓５の下側に酸素ガスプラズマ２８が形成される。

【００３０】酸素ガスプラズマ２８の内部における電子のエネルギーは非常に大きい。酸素ガス供給ノズル１４と反応ガス供給ノズル２１との間に配置された電極５１に－３０Ｖの電圧を印加することによって、この様な高エネルギー電子が酸素プラズマ生成領域２８からウエハ２０の表面近傍の領域へ侵入することが防止され、ジクロールシランガスの過分解が抑制される。

【００３１】一方、酸素ガスプラズマ２８中で生成された活性酸素は、1.6×10^{-19} Ｃの電荷を有しているので、電極５１によって加速されて、電極５１に設けられた貫通孔５２を通過し、ウエハ２０の表面近傍に到達する。ウエハ２０の表面近傍に供給されたジクロールシランガスは、この活性酸素によって分解されてウエハ２０上にSiO_2の薄膜が堆積する。

【００３２】なお、堆積した膜厚の管理は、その場観察で管理してもよいし、成膜速度と時間で管理してもよい。薄膜の形成が完了した後、高周波電源８及び電源５３を切り、酸素ガス及びジクロールシランガスの供給を停止し、これらのガスを、反応室１内から排気管２６を介して排気して、薄膜の形成プロセスが終了する。

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【００３３】なお、本発明は図１の例に示した構成に限定されず、種々の変形を施して適用することができる。例えば、誘電体窓５としては、石英のほか、電波は透過するが赤外線は透過しないアルミナの様な材料も使用できる。リング状アンテナ６を、必要に応じて、その内部に冷却水を流す様に管状部材で構成することもできる。ステージ４１は、この例では固定式としているが、薄膜形成速度のウエハ内均一性を向上すべく、回転可能な構造とすることもできる。この例では、ウエハ２０の昇温は行っていないが、昇温を行う場合にはステージ４１の内部にヒータを組込む。ウエハ２０の保持は、単にステージ４１の上に載置するだけでもよいし、真空チャック等を使用してステージ４１に固定することもできる。

【００３４】また、グリッド状の電極５１は、金属板に多数の丸穴のほか長穴を設けたものでもよいし、あるいは金網状のものでもよい。また、電極５１に起因する反応室内のコンタミネーションが問題となる場合には、電極５１を石英硝子等で被覆する。但し、その場合には、電源５３を高周波電源にして、電極５１には高周波電圧を供給する必要があり、また、マッチングボックスが必要となる。

【００３５】また、供給する酸素ガスの中に、例えば窒素ガスの様な不活性ガスを混入してもよい。この様な方法は、例えば光導波路の製作の場合に屈折率を変化させて成膜する場合に有用である。

【００３６】

【実施例】従来の構造の誘導結合型プラズマＣＶＤ装置を用いて、アンテナに３ＫＷの高周波電力を印加して薄膜形成を行った場合、アンテナとウエハ表面までの距離を４０ｍｍまで近付けると、Ｓｉ微粒子の発生がみられ、膜質が非常に悪くなった。しかし、本発明の誘導結合型プラズマＣＶＤ装置では、上記と同じ条件で薄膜の形成を行ったところ、膜質上、全く問題なく、また成膜速度として５μｍ／ｍｉｎが得られた。

【００３７】

【発明の効果】本発明による誘導結合型プラズマＣＶＤ装置では、酸素ガス供給ノズルと反応ガス供給ノズルとの間に、グリッド状の電極を配置することによって。酸素ガスプラズマ形成領域からウエハ表面までの距離、従って、アンテナからウエハ表面までの距離を短縮することができる。

【００３８】この結果、プラズマ中で生成された活性酸素が効率良くウエハ表面に供給される様になり、設備コスト及びランニングコストの増大を招くことなく、良質のＣＶＤ薄膜を効率良く形成することが可能になった。

【図面の簡単な説明】

【図１】本発明に基く誘導結合型プラズマＣＶＤ装置の

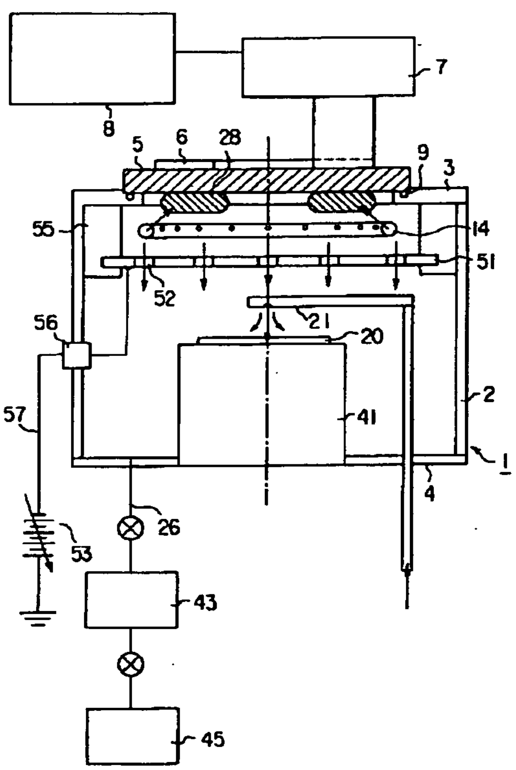
一例を示す図。

【図２】従来の誘導結合型プラズマＣＶＤ装置の一例を示す図。

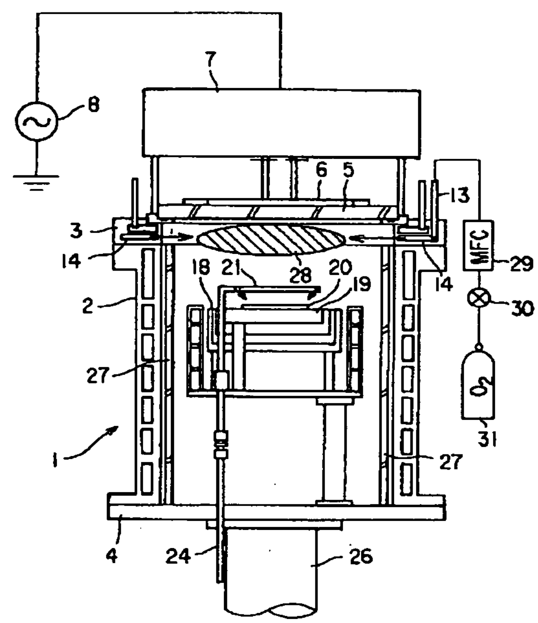
【符号の説明】

１・・・反応室、
２・・・側壁、
３・・・上蓋、
４・・・下蓋、
５・・・誘電体窓、
６・・・リング状アンテナ、
７・・・マッチングボックス、
８・・・高周波電源（第一の電源）、
１４・・・酸素ガス供給ノズル、
１９・・・ヒータ、
＊２０・・・ウエハ、
２１・・・反応ガス供給ノズル、
２６・・・排気管、
２７・・・石英製の円環、
２８・・・酸素ガスプラズマ、
３１・・・酸素ガスのボンベ、
４１・・・ステージ、
４３・・・ターボ分子ポンプ、
４５・・・ロータリーポンプ、
５１・・・グリッド状の電極、
５２・・・貫通孔、
５３・・・電源（第二の電源）、
５５、５６・・・絶縁碍子。
＊

【図１】



【図２】



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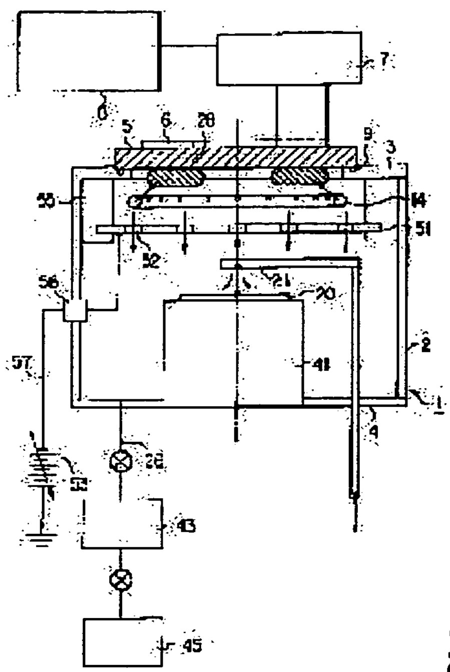
(54) INDUCTIVE COUPLED PLASMA CVD DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To shorten the distance from a gaseous oxygen plasma formation area to the surface of a wafer, therefore, the distance from an antenna to the wafer surface and effectively form a CVD thin film of good quality by providing a grid-shaped electrode between a gaseous oxygen supply nozzle and a reactive gas supply nozzle.

SOLUTION: Between the gaseous oxygen supply nozzle 14 and reactive gas supply nozzle 21, the grid-shaped electrode 51 is so arranged as to completely shield the lower side of the ring-shaped gaseous oxygen supply nozzle 14. The energy of electrons in gaseous oxygen plasma 28 is very large. The electrode 51 is applied with a voltage of, for example, -30V. Consequently, the high-energy electrons are prevented from an area nearby the surface of the wafer 20 from the gaseous oxygen plasma generation area 28. Therefore, the over decomposition of gaseous dichlorosilane can be suppressed.



LEGAL STATUS

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[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] A reaction chamber, an exhaust air means to exhaust the interior of a reaction chamber, and the stage that is arranged inside a reaction chamber and supports processed material, The dielectric window which the party wall which is prepared so that said stage may be countered, and constitutes a reaction chamber makes in part, The antenna which approached said dielectric window and has been arranged to the exterior of a reaction chamber, and the first power source which supplies high-frequency power to said antenna, The oxygen gas supply nozzle which approaches said dielectric window, is arranged inside a reaction chamber, and supplies oxygen gas to the interior of a reaction chamber, In the inductive coupled plasma CVD system equipped with the reactant gas supply nozzle which approaches the field which supports the processed material of said stage, is arranged, and supplies reactant gas to the interior of a reaction chamber The inductive coupled plasma CVD system characterized by establishing the second power source which supplies an electrical potential difference to the electrode of the shape of this grid while arranging a grid-like electrode between said oxygen gas supply nozzle and said reactant gas supply nozzle.
[Claim 2] The inductive-coupling mold BURAZUMA CVD system according to claim 1 characterized by using said second power source as an RF generator while covering the electrode of the shape of said grid with a quartz.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention — an inductive coupled plasma CVD system — starting — especially — the oxygen gas plasma — using — reactant gas — decomposing — a sample top — SiO2 etc. — it is related with the inductive coupled plasma CVD system on which a thin film is made to deposit.
[0002]
[Description of the Prior Art] An example of the structure of the conventional inductive coupled plasma CVD system (Inductive Coupled Plasma CVD System) is shown in drawing 2 . The reaction chamber 1 consists of a side attachment wall 2, a top cover 3, and a lower lid 4. In the reaction chamber 1, the circular ring 27 made from a quartz is arranged along with the inner circumference of a side attachment wall 2. The dielectric window 5 made from a quartz is formed in the top face of a top cover 3, and the ring-like antenna 6 is installed by copper on the dielectric window 5. The antenna 6 is connected to RF generator 8 through the matching box 7.
[0003] The oxygen gas supply nozzle 14 which supplies oxygen gas in a reaction chamber 1 is formed in a top cover 3, and the piping 13 for oxygen gas supply is connected to this oxygen gas supply nozzle 14. Oxygen gas is supplied near the bottom of the dielectric window 5 in a reaction chamber 1 through a bomb 31, a ball valve 30, a flow control valve 29, piping 13, and the oxygen gas supply nozzle 14.
[0004] On the other hand, the wafer 20 which is processed material is set on the heater 19 supported by the lower lid 4. Around the heater 19, several sets of reflecting plates 18 are arranged. The ring-like reactant gas supply nozzle 21 is formed above the heater 19 by the product made from a quartz, and reactant gas is turned to the inside of the ring concerned, and it spouts. The piping 24 which penetrates the lower lid 4 is connected to this reactant gas supply nozzle 21, and reactant gas is supplied from the exterior of a reaction chamber through piping 24. Moreover, the exhaust pipe 26 is connected to the lower lid 4, and evacuation inside a reaction chamber 1 is performed.
[0005] Next, it is the outline of operation of this inductive coupled plasma CVD system on a wafer 20 SiO2 The case where a thin film is formed is taken and explained to an example. first, the exhaust pipe 26 after setting a wafer 20 on the heater 19 in a reaction chamber 1 — minding — the inside of a reaction chamber 1 — a vacuum pump (not shown) — for example, 10-6 Torr up to — evacuation is carried out.
[0006] Power is supplied to a heater 19 and a temperature up is carried out to (about 300-500 degrees C) to predetermined temperature. While supplying oxygen gas to the interior of a reaction chamber 1 through the oxygen gas supply nozzle 14, JIKURORU silane gas (SiH2 Cl2) is supplied at a predetermined rate to oxygen gas after a temperature up through the reactant gas supply nozzle 21 as reactant gas.
[0007] After adjusting the pressure in a reaction chamber 1 to a predetermined pressure, high-frequency power is supplied to an antenna 6 through a matching box 7. The oxygen gas supplied in the reaction chamber 1 is excited by this, and the oxygen gas plasma 28 is formed in the dielectric window 5 bottom of it. It is decomposed by the active oxygen supplied out of the oxygen gas plasma 28, consequently the JIKURORU silane gas supplied near the front face of a wafer 20 is SiO2 on a wafer 20. A thin film accumulates.
[0008] After formation of a thin film is completed, RF generator 8 is shut off, supply of oxygen gas and JIKURORU silane gas is suspended, these gas is exhausted through an exhaust pipe 26 from the inside of a reaction chamber 1, and the formation process of a thin film is completed.
[0009] (Trouble of a Prior art) There are the following troubles about the conventional inductive coupled plasma CVD system equipped with the above structures.
[0010] a. Good SiO2 In order to obtain a thin film, it is required to supply the active oxygen generated in the

plasma to a wafer front face in sufficient amount. However, since the life of active oxygen is very short, the distance of the plasma and a wafer must be brought as much as possible close. In addition, when there is little amount of supply of active oxygen, it is good SiO_2. A thin film is not obtained but it becomes factors, such as crack initiation.
[0011] b. It is shortened by the distance of the supply nozzle of a JIKURORU silane, and the plasma as spacing of the plasma and a wafer is brought close, since the JIKURORU silane is supplied from near the front face of a wafer. If a thin film is formed in such the condition, since a JIKURORU silane will also be decomposed by the high energy electron formed in coincidence in the plasma and Si particle will be formed in a gaseous phase of it, a good thin film is not obtained too.
[0012] c. If ON/OFF of high-frequency power is performed on a predetermined frequency in order to control the excessive solution of the above JIKURORU silanes, and to aim at the fall of the electron temperature in the plasma, as a result of electron temperature's falling and also controlling activation of oxygen gas in connection with this, it will curve and membraneous quality will deteriorate.
[0013] d. Moreover, since the rate of sedimentation of a thin film is increased, if the flow rate of a JIKURORU silane is increased, the amounts of active oxygen run short. Moreover, if the flow rate of the oxygen gas supplied that this should be improved is increased, it is necessary to increase the capacity of an exhauster. However, if capacity of an exhauster is enlarged, the jump of facility cost will be caused.
[0014]
[Problem(s) to be Solved by the Invention] It is in offering the inductive coupled plasma CVD system which can form a good CVD thin film efficiently, without the technical problem of this invention causing increase of facility cost and a running cost in view of the above problems.
 [0015]
[Means for Solving the Problem] An exhaust air means by which the inductive coupled plasma CVD system of this invention exhausts the interior of a reaction chamber and a reaction chamber, The dielectric window which the party wall which is arranged inside a reaction chamber, is prepared so that the stage which supports processed material, and said stage may be countered, and constitutes a reaction chamber makes in part, The antenna which approached said dielectric window and has been arranged to the exterior of a reaction chamber, and the first power source which supplies high-frequency power to said antenna, The oxygen gas supply nozzle which approaches said dielectric window, is arranged inside a reaction chamber, and supplies oxygen gas to the interior of a reaction chamber, In the inductive coupled plasma CVD system equipped with the reactant gas supply nozzle which approaches the field which supports the processed material of said stage, is arranged, and supplies reactant gas to the interior of a reaction chamber It is characterized by establishing the second power source which supplies an electrical potential difference to the electrode of the shape of this grid between said oxygen gas supply nozzle and said reactant gas supply nozzle, while having arranged the grid-like electrode.
[0016] In addition, the electrode of the shape of an above grid means the electrode of the configuration like the metal plate with which many through tubes were prepared, or a metal grid which can be easily penetrated by the gas.
[0017] Moreover, this electrode is covered with silica glass etc. when the contamination in the reaction chamber resulting from the electrode of the shape of said grid poses a problem. However, it is necessary to supply high-frequency voltage to the electrode of the shape of said grid by using said second power source as an RF generator in that case.
[0018] Below, an operation of the inductive coupled plasma CVD system by this invention is explained. The oxygen gas supplied near the dielectric window from the oxygen gas supply nozzle will be excited by the RF electric field formed by the antenna, and will be in the plasma state. On the other hand, the reactant gas supplied near the front face of the processed material on a stage from the reactant gas supply nozzle is decomposed by the active oxygen which was generated in the oxygen gas plasma and reached near the front face of processed material, consequently deposition of a thin film takes place to the front face of processed material.
[0019] In the inductive coupled plasma CVD system by this invention, the grid-like electrode has been arranged between the above oxygen gas plasma production fields and the field near the front face of processed material to which reactant gas is supplied, and between these two fields is divided into it.
[0020] He is trying for the high energy electron leading to the excessive solution to not to trespass upon the field near the front face of processed material from an oxygen gas plasma production field by impressing a predetermined electrical potential difference into the process of thin film formation at said electrode. That is, if potential of said electrode is made equal to plasma potential, the current (namely, flow of ion and an electron)

which flows between a plasma production field and the fields near the front face of processed material will be lost. Moreover, if potential of said electrode is made small compared with plasma potential, it will be prevented that a high energy electron trespasses upon the field near the front face of processed material from a plasma production field, and the excessive solution to will be controlled.
[0021]
[Embodiment of the Invention] An example of the structure of an inductive coupled plasma CVD system based on this invention is shown in drawing 1 . The reaction chamber 1 consists of a side attachment wall 2, a top cover 3, and a lower lid 4. The dielectric window 5 made from a quartz is formed in the top face of a top cover 3. The copper ring-like antenna 6 is installed on the dielectric window 5, and the ring-like antenna 6 is connected to RF generator 8 (the first power source) through the matching box 7. Between the dielectric window 5 and the top cover 3, O ring 9 is arranged and the seal of the interior of a reaction chamber 1 is carried out.
[0022] The stage 41 is installed on the lower lid 4 of a reaction chamber 1, and a wafer 20 (processed material) is set to the upper part of a stage 41. In addition, in this example, the size of a wafer 20 is 6 inches (150mmphi).
[0023] The exhaust pipe 26 is connected to the lower lid 4, a turbo molecular pump 43 is connected to an exhaust pipe 26, and the exhaust side is connected to the rotary pump 45. The oxygen gas supply nozzle 14 of the shape of a ring which turns and supplies oxygen gas to the inferior surface of tongue of a dielectric window 5 is arranged at the top-cover 3 bottom of a reaction chamber 1. This oxygen gas supply nozzle 14 is connected to the oxygen cylinder (not shown) arranged to the exterior of a reaction chamber 1. In addition, the effective diameter of a dielectric window 5 is 300mm, and the distance from the inferior surface of tongue of a dielectric window 5 to the oxygen gas supply nozzle 14 is 15mm.
[0024] The reactant gas supply nozzle 21 which supplies JIKURORU silane gas (reactant gas) near the front face of a wafer 20 above the stage 41 is arranged, and the reactant gas supply nozzle 21 is connected to the reactant gas source of supply (not shown) arranged to the exterior of a reaction chamber 1. As shown in drawing 1 , the reactant gas supply nozzle 21 is located above the core of a wafer 20, turns JIKURORU silane gas to wafer 20 downward front face, and spouts it. In addition, the distance from the wafer 20 to the reactant gas supply nozzle 21 is 25mm.
[0025] Furthermore, between the oxygen gas supply nozzle 14 and the reactant gas supply nozzle 21, the grid-like electrode 51 is arranged so that the ring-like nozzle [oxygen gas supply] 14 bottom may be covered completely. This electrode 51 is copper sheet metal with 1mm [in thickness], and a diameter of 320mm, and the through tube 52 with a diameter of 3mm is arranged by this electrode 51 in 6mm pitch of each every direction. Moreover, the distance from 10mm and the electrode 51 to the reactant gas supply nozzle 21 of the distance from the electrode 51 to the oxygen gas supply nozzle 14 is 18mm.
[0026] The power source 53 (the second power source) which supplies an electrical potential difference to an electrode 51 is formed in the exterior of a reaction chamber. In addition, the electrode 51 is attached in the reaction chamber 1 using the insulating insulator 55, and the insulating insulator 56 is formed in the part by which the wiring 57 which connects an electrode 51 with a power source 53 penetrates a reaction chamber 1.
[0027] Next, it is SiO2 to the front face of a wafer 20 about operation of this inductive coupled plasma CVD system. It explains taking the case of the case where a thin film is formed. the interior of the reaction chamber 1 after setting a wafer 20 on the stage 41 in a reaction chamber 1 -- an exhaust pipe 26 -- minding -- a turbo molecular pump 43 -- 10-6 Torr up to -- it exhausts.
[0028] From the oxygen gas supply nozzle 14, the oxygen gas of 0.5SLM is supplied to the interior of a reaction chamber 1. From the reactant gas supply nozzle 21, the JIKURORU silane gas (SiH2 Cl2) of 0.1SLM is supplied.
[0029] It is 10-2 Torr about the pressure in a reaction chamber 1. After adjusting, the electrical potential difference of -30V is impressed to an electrode 51. 3kW high-frequency power is supplied to the ring-like antenna 6 through a matching box 7 from RF generator 8. Oxygen gas is excited by the above and the oxygen gas plasma 28 is formed in the dielectric window 5 bottom of it.
[0030] The energy of the electron in the interior of the oxygen gas plasma 28 is very large. By impressing the electrical potential difference of -30V to the electrode 51 arranged between the oxygen gas supply nozzle 14 and the reactant gas supply nozzle 21, it is prevented that such a high energy electron trespasses upon the field near the front face of a wafer 20 from the oxygen plasma production field 28, and the excessive solution of JIKURORU silane gas is controlled.
[0031] On the other hand, since the active oxygen generated in the oxygen gas plasma 28 has the charge of 1.6x10-19 C, it is accelerated with an electrode 51, and it passes the through tube 52 prepared in the electrode 51, and reaches near the front face of a wafer 20. It is decomposed by this active oxygen and the JIKURORU

silane gas supplied near the front face of a wafer 20 is SiO2 on a wafer 20. A thin film accumulates.
[0032] In addition, management of the deposited thickness may be managed by in situ observation, and may be managed by the membrane formation rate and time amount. After formation of a thin film is completed, RF generator 8 and a power source 53 are shut off, supply of oxygen gas and JIKURORU silane gas is suspended, these gas is exhausted through an exhaust pipe 26 from the inside of a reaction chamber 1, and the formation process of a thin film is completed.
[0033] In addition, this invention is not limited to the configuration shown in the example of drawing 1 , but can perform and apply various deformation. For example, as a dielectric window 5, although an electric wave besides a quartz is penetrated, infrared radiation can also use an ingredient like the alumina which is not penetrated. If needed, the ring-like antenna 6 can also consist of tubular members so that cooling water may be poured to the interior. Although the stage 41 is made fixed in this example, it can also make pivotable structure homogeneity in a wafer of a thin film formation rate that it should improve. In this example, although not carried out, the temperature up of a wafer 20 builds a heater into the interior of a stage 41, when performing a temperature up. It is also good to lay on a stage 41, and it can also fix maintenance of a wafer 20 to a stage 41 using a vacuum chuck etc.
[0034] Moreover, what prepared many slots besides a round hole in the metal plate is sufficient as the grid-like electrode 51, or a wire gauze-like thing is sufficient as it. Moreover, an electrode 51 is covered with silica glass etc. when the contamination in the reaction chamber resulting from an electrode 51 poses a problem. However, it is necessary to use a power source 53 as an RF generator, and to supply high-frequency voltage to an electrode 51 in that case, and, and a matching box is needed.
[0035] Moreover, inert gas like nitrogen gas may be mixed into the oxygen gas to supply. Such an approach is useful, when changing a refractive index in manufacture of optical waveguide and forming membranes.
[0036]
[Example] When 3kW high-frequency power was impressed to an antenna, thin film formation was performed using the inductive coupled plasma CVD system of the conventional structure and the distance to an antenna and a wafer front face was close brought to 40mm, generating of Si particle was seen and membraneous quality got very bad. However, in the inductive coupled plasma CVD system of this invention, when the thin film was formed on the same conditions as the above, 5 micrometer/min was completely obtained as a membrane formation rate satisfactory on membraneous quality.
[0037]
[Effect of the Invention] In the inductive coupled plasma CVD system by this invention, a grid-like electrode is arranged between an oxygen gas supply nozzle and a reactant gas supply nozzle. The distance from an oxygen gas plasma formation field to a wafer front face, therefore the distance from an antenna to a wafer front face can be shortened.
[0038] Consequently, it became possible to form a good CVD thin film efficiently, without having come to supply efficiently the active oxygen generated in the plasma to a wafer front face, and causing increase of facility cost and a running cost.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] this invention -- an inductive coupled plasma CVD system -- starting -- especially -- the oxygen gas plasma -- using -- reactant gas -- decomposing -- a sample top -- SiO2 etc. -- it is related with the inductive coupled plasma CVD system on which a thin film is made to deposit.

[Translation done.]

PRIOR ART

[Description of the Prior Art] An example of the structure of the conventional inductive coupled plasma CVD system (Inductive Coupled Plasma CVD System) is shown in drawing 2 . The reaction chamber 1 consists of a side attachment wall 2, a top cover 3, and a lower lid 4. In the reaction chamber 1, the circular ring 27 made from a quartz is arranged along with the inner circumference of a side attachment wall 2. The dielectric window 5 made from a quartz is formed in the top face of a top cover 3, and the ring-like antenna 6 is installed by copper on the dielectric window 5. The antenna 6 is connected to RF generator 8 through the matching box 7.
[0003] The oxygen gas supply nozzle 14 which supplies oxygen gas in a reaction chamber 1 is formed in a top cover 3, and the piping 13 for oxygen gas supply is connected to this oxygen gas supply nozzle 14. Oxygen gas is supplied near the bottom of the dielectric window 5 in a reaction chamber 1 through a bomb 31, a ball valve 30, a flow control valve 29, piping 13, and the oxygen gas supply nozzle 14.
[0004] On the other hand, the wafer 20 which is processed material is set on the heater 19 supported by the lower lid 4. Around the heater 19, several sets of reflecting plates 18 are arranged. The ring-like reactant gas supply nozzle 21 is formed above the heater 19 by the product made from a quartz, and reactant gas is turned to the inside of the ring concerned, and it spouts. The piping 24 which penetrates the lower lid 4 is connected to this reactant gas supply nozzle 21, and reactant gas is supplied from the exterior of a reaction chamber through piping 24. Moreover, the exhaust pipe 26 is connected to the lower lid 4, and evacuation inside a reaction chamber 1 is performed.
[0005] Next, it is the outline of operation of this inductive coupled plasma CVD system on a wafer 20 SiO2 The case where a thin film is formed is taken and explained to an example. first, the exhaust pipe 26 after setting a wafer 20 on the heater 19 in a reaction chamber 1 -- minding -- the inside of a reaction chamber 1 -- a vacuum pump (not shown) -- for example, 10-6 Torr up to -- evacuation is carried out.
[0006] Power is supplied to a heater 19 and a temperature up is carried out to (about 300-500 degrees C) to predetermined temperature. While supplying oxygen gas to the interior of a reaction chamber 1 through the oxygen gas supply nozzle 14, JIKURORU silane gas (SiH2 Cl2) is supplied at a predetermined rate to oxygen gas after a temperature up through the reactant gas supply nozzle 21 as reactant gas.
[0007] After adjusting the pressure in a reaction chamber 1 to a predetermined pressure, high-frequency power is supplied to an antenna 6 through a matching box 7. The oxygen gas supplied in the reaction chamber 1 is excited by this, and the oxygen gas plasma 28 is formed in the dielectric window 5 bottom of it. It is decomposed by the active oxygen supplied out of the oxygen gas plasma 28, consequently the JIKURORU silane gas supplied near the front face of a wafer 20 is SiO2 on a wafer 20. A thin film accumulates.
[0008] After formation of a thin film is completed, RF generator 8 is shut off, supply of oxygen gas and JIKURORU silane gas is suspended, these gas is exhausted through an exhaust pipe 26 from the inside of a reaction chamber 1, and the formation process of a thin film is completed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] In the inductive coupled plasma CVD system by this invention, a grid-like electrode is arranged between an oxygen gas supply nozzle and a reactant gas supply nozzle. The distance from an oxygen gas plasma formation field to a wafer front face, therefore the distance from an antenna to a wafer front face can be shortened.

[0038] Consequently, it became possible to form a good CVD thin film efficiently, without having come to supply efficiently the active oxygen generated in the plasma to a wafer front face, and causing increase of facility cost and a running cost.

[Translation done.]

TECHNICAL PROBLEM

(Trouble of a Prior art) There are the following troubles about the conventional inductive coupled plasma CVD system equipped with the above structures.

[0010] a. Good SiO2 In order to obtain a thin film, it is required to supply the active oxygen generated in the plasma to a wafer front face in sufficient amount. However, since the life of active oxygen is very short, the distance of the plasma and a wafer must be brought as much as possible close. In addition, when there is little amount of supply of active oxygen, it is good SiO2. A thin film is not obtained but it becomes factors, such as crack initiation.

[0011] b. It is shortened by the distance of the supply nozzle of a JIKURORU silane, and the plasma as spacing of the plasma and a wafer is brought close, since the JIKURORU silane is supplied from near the front face of a wafer. If a thin film is formed in such the condition, since a JIKURORU silane will also be decomposed by the high energy electron formed in coincidence in the plasma and Si particle will be formed in a gaseous phase of it, a good thin film is not obtained too.

[0012] c. If ON/OFF of high-frequency power is performed on a predetermined frequency in order to control the excessive solution of the above JIKURORU silanes, and to aim at the fall of the electron temperature in the plasma, as a result of electron temperature's falling and also controlling activation of oxygen gas in connection with this, it will curve and membraneous quality will deteriorate.

[0013] d. Moreover, since the rate of sedimentation of a thin film is increased, if the flow rate of a JIKURORU silane is increased, the amounts of active oxygen run short. Moreover, if the flow rate of the oxygen gas supplied that this should be improved is increased, it is necessary to increase the capacity of an exhauster. However, if capacity of an exhauster is enlarged, the jump of facility cost will be caused.

[Translation done.]

MEANS

[Means for Solving the Problem] An exhaust air means by which the inductive coupled plasma CVD system of this invention exhausts the interior of a reaction chamber and a reaction chamber, The dielectric window which the party wall which is arranged inside a reaction chamber, is prepared so that the stage which supports processed material, and said stage may be countered, and constitutes a reaction chamber makes in part, The antenna which approached said dielectric window and has been arranged to the exterior of a reaction chamber, and the first power source which supplies high-frequency power to said antenna, The oxygen gas supply nozzle which approaches said dielectric window, is arranged inside a reaction chamber, and supplies oxygen gas to the interior of a reaction chamber, In the inductive coupled plasma CVD system equipped with the reactant gas supply nozzle which approaches the field which supports the processed material of said stage, is arranged, and supplies reactant gas to the interior of a reaction chamber It is characterized by establishing the second power source which supplies an electrical potential difference to the electrode of the shape of this grid between said oxygen gas supply nozzle and said reactant gas supply nozzle, while having arranged the grid-like electrode.
[0016] In addition, the electrode of the shape of an above grid means the electrode of the configuration like the metal plate with which many through tubes were prepared, or a metal grid which can be easily penetrated by the gas.
[0017] Moreover, this electrode is covered with silica glass etc. when the contamination in the reaction chamber resulting from the electrode of the shape of said grid poses a problem. However, it is necessary to supply high-frequency voltage to the electrode of the shape of said grid by using said second power source as an RF generator in that case.
[0018] Below, an operation of the inductive coupled plasma CVD system by this invention is explained. The oxygen gas supplied near the dielectric window from the oxygen gas supply nozzle will be excited by the RF electric field formed by the antenna, and will be in the plasma state. On the other hand, the reactant gas supplied near the front face of the processed material on a stage from the reactant gas supply nozzle is decomposed by the active oxygen which was generated in the oxygen gas plasma and reached near the front face of processed material, consequently deposition of a thin film takes place to the front face of processed material.
[0019] In the inductive coupled plasma CVD system by this invention, the grid-like electrode has been arranged between the above oxygen gas plasma production fields and the field near the front face of processed material to which reactant gas is supplied, and between these two fields is divided into it.
[0020] He is trying for the high energy electron leading to the excessive solution to not to trespass upon the field near the front face of processed material from an oxygen gas plasma production field by impressing a predetermined electrical potential difference into the process of thin film formation at said electrode. That is, if potential of said electrode is made equal to plasma potential, the current (namely, flow of ion and an electron) which flows between a plasma production field and the fields near the front face of processed material will be lost. Moreover, if potential of said electrode is made small compared with plasma potential, it will be prevented that a high energy electron trespasses upon the field near the front face of processed material from a plasma production field, and the excessive solution to will be controlled.
[0021]
[Embodiment of the Invention] An example of the structure of an inductive coupled plasma CVD system based on this invention is shown in drawing 1 . The reaction chamber 1 consists of a side attachment wall 2, a top cover 3, and a lower lid 4. The dielectric window 5 made from a quartz is formed in the top face of a top cover 3. The copper ring-like antenna 6 is installed on the dielectric window 5, and the ring-like antenna 6 is connected

to RF generator 8 (the first power source) through the matching box 7. Between the dielectric window 5 and the top cover 3, O ring 9 is arranged and the seal of the interior of a reaction chamber 1 is carried out.
[0022] The stage 41 is installed on the lower lid 4 of a reaction chamber 1, and a wafer 20 (processed material) is set to the upper part of a stage 41. In addition, in this example, the size of a wafer 20 is 6 inches (150mmphi).
[0023] The exhaust pipe 26 is connected to the lower lid 4, a turbo molecular pump 43 is connected to an exhaust pipe 26, and the exhaust side is connected to the rotary pump 45. The oxygen gas supply nozzle 14 of the shape of a ring which turns and supplies oxygen gas to the inferior surface of tongue of a dielectric window 5 is arranged at the top-cover 3 bottom of a reaction chamber 1. This oxygen gas supply nozzle 14 is connected to the oxygen cylinder (not shown) arranged to the exterior of a reaction chamber 1. In addition, the effective diameter of a dielectric window 5 is 300mm, and the distance from the inferior surface of tongue of a dielectric window 5 to the oxygen gas supply nozzle 14 is 15mm.
[0024] The reactant gas supply nozzle 21 which supplies JIKURORU silane gas (reactant gas) near the front face of a wafer 20 above the stage 41 is arranged, and the reactant gas supply nozzle 21 is connected to the reactant gas source of supply (not shown) arranged to the exterior of a reaction chamber 1. As shown in drawing 1 , the reactant gas supply nozzle 21 is located above the core of a wafer 20, turns JIKURORU silane gas to wafer 20 downward front face, and spouts it. In addition, the distance from the wafer 20 to the reactant gas supply nozzle 21 is 25mm.
[0025] Furthermore, between the oxygen gas supply nozzle 14 and the reactant gas supply nozzle 21, the grid-like electrode 51 is arranged so that the ring-like nozzle [oxygen gas supply] 14 bottom may be covered completely. This electrode 51 is copper sheet metal with 1mm [in thickness], and a diameter of 320mm, and the through tube 52 with a diameter of 3mm is arranged by this electrode 51 in 6mm pitch of each every direction. Moreover, the distance from 10mm and the electrode 51 to the reactant gas supply nozzle 21 of the distance from the electrode 51 to the oxygen gas supply nozzle 14 is 18mm.
[0026] The power source 53 (the second power source) which supplies an electrical potential difference to an electrode 51 is formed in the exterior of a reaction chamber. In addition, the electrode 51 is attached in the reaction chamber 1 using the insulating insulator 55, and the insulating insulator 56 is formed in the part by which the wiring 57 which connects an electrode 51 with a power source 53 penetrates a reaction chamber 1.
[0027] Next, it is SiO_2 to the front face of a wafer 20 about operation of this inductive coupled plasma CVD system. It explains taking the case of the case where a thin film is formed. the interior of the reaction chamber 1 after setting a wafer 20 on the stage 41 in a reaction chamber 1 -- an exhaust pipe 26 -- minding -- a turbo molecular pump 43 -- 10^{-6} Torr up to -- it exhausts.
[0028] From the oxygen gas supply nozzle 14, the oxygen gas of 0.5SLM is supplied to the interior of a reaction chamber 1. From the reactant gas supply nozzle 21, the JIKURORU silane gas (SiH_2Cl_2) of 0.1SLM is supplied.
[0029] It is 10^{-2} Torr about the pressure in a reaction chamber 1. After adjusting, the electrical potential difference of -30V is impressed to an electrode 51. 3kW high-frequency power is supplied to the ring-like antenna 6 through a matching box 7 from RF generator 8. Oxygen gas is excited by the above and the oxygen gas plasma 28 is formed in the dielectric window 5 bottom of it.
[0030] The energy of the electron in the interior of the oxygen gas plasma 28 is very large. By impressing the electrical potential difference of -30V to the electrode 51 arranged between the oxygen gas supply nozzle 14 and the reactant gas supply nozzle 21, it is prevented that such a high energy electron trespasses upon the field near the front face of a wafer 20 from the oxygen plasma production field 28, and the excessive solution of JIKURORU silane gas is controlled.
[0031] On the other hand, since the active oxygen generated in the oxygen gas plasma 28 has the charge of 1.6×10^{-19} C, it is accelerated with an electrode 51, and it passes the through tube 52 prepared in the electrode 51, and reaches near the front face of a wafer 20. It is decomposed by this active oxygen and the JIKURORU silane gas supplied near the front face of a wafer 20 is SiO_2 on a wafer 20. A thin film accumulates.
[0032] In addition, management of the deposited thickness may be managed by in situ observation, and may be managed by the membrane formation rate and time amount. After formation of a thin film is completed, RF generator 8 and a power source 53 are shut off, supply of oxygen gas and JIKURORU silane gas is suspended, these gas is exhausted through an exhaust pipe 26 from the inside of a reaction chamber 1, and the formation process of a thin film is completed.
[0033] In addition, this invention is not limited to the configuration shown in the example of drawing 1 , but can perform and apply various deformation. For example, as a dielectric window 5, although an electric wave besides a quartz is penetrated, infrared radiation can also use an ingredient like the alumina which is not penetrated. If

needed, the ring-like antenna 6 can also consist of tubular members so that cooling water may be poured to the interior. Although the stage 41 is made fixed in this example, it can also make pivotable structure homogeneity in a wafer of a thin film formation rate that it should improve. In this example, although not carried out, the temperature up of a wafer 20 builds a heater into the interior of a stage 41, when performing a temperature up. It is also good to lay on a stage 41, and it can also fix maintenance of a wafer 20 to a stage 41 using a vacuum chuck etc.

[0034] Moreover, what prepared many slots besides a round hole in the metal plate is sufficient as the grid-like electrode 51, or a wire gauze-like thing is sufficient as it. Moreover, an electrode 51 is covered with silica glass etc. when the contamination in the reaction chamber resulting from an electrode 51 poses a problem. However, it is necessary to use a power source 53 as an RF generator, and to supply high-frequency voltage to an electrode 51 in that case, and, and a matching box is needed.

[0035] Moreover, inert gas like nitrogen gas may be mixed into the oxygen gas to supply. Such an approach is useful, when changing a refractive index in manufacture of optical waveguide and forming membranes.

[Translation done.]

EXAMPLE

[Example] When 3kW high-frequency power was impressed to an antenna, thin film formation was performed using the inductive coupled plasma CVD system of the conventional structure and the distance to an antenna and a wafer front face was close brought to 40mm, generating of Si particle was seen and membraneous quality got very bad. However, in the inductive coupled plasma CVD system of this invention, when the thin film was formed on the same conditions as the above, 5 micrometer/min was completely obtained as a membrane formation rate satisfactory on membraneous quality.

[Translation done.]

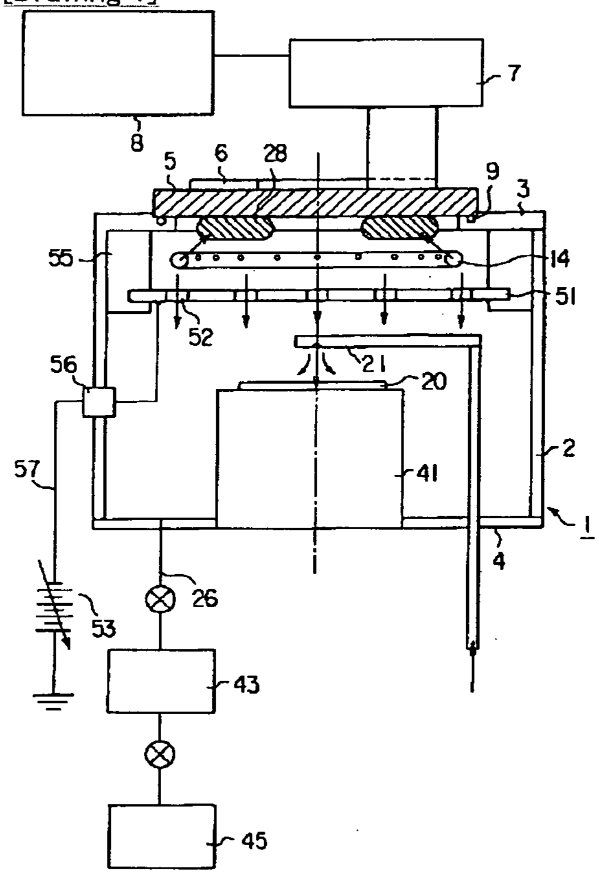
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing an example of an inductive coupled plasma CVD system based on this invention.
[Drawing 2] Drawing showing an example of the conventional inductive coupled plasma CVD system.
[Description of Notations]
1 ... Reaction chamber,
2 ... Side attachment wall,
3 ... Top cover,
4 ... Bottom lid,
5 ... Dielectric window,
6 ... Ring-like antenna,
7 ... Matching box,
8 ... RF generator (the first power source),
14 ... Oxygen gas supply nozzle,
19 ... Heater,
20 ... Wafer,
21 ... Reactant gas supply nozzle,
26 ... Exhaust pipe,
27 ... Circular ring made from a quartz,
28 ... Oxygen gas plasma,
31 ... Bomb of oxygen gas,
41 ... Stage,
43 ... Turbo molecular pump
45 ... Rotary pump,
51 ... Grid-like electrode,
52 ... Through tube,
53 ... Power source (the second power source),
55 56 ... Insulating insulator.

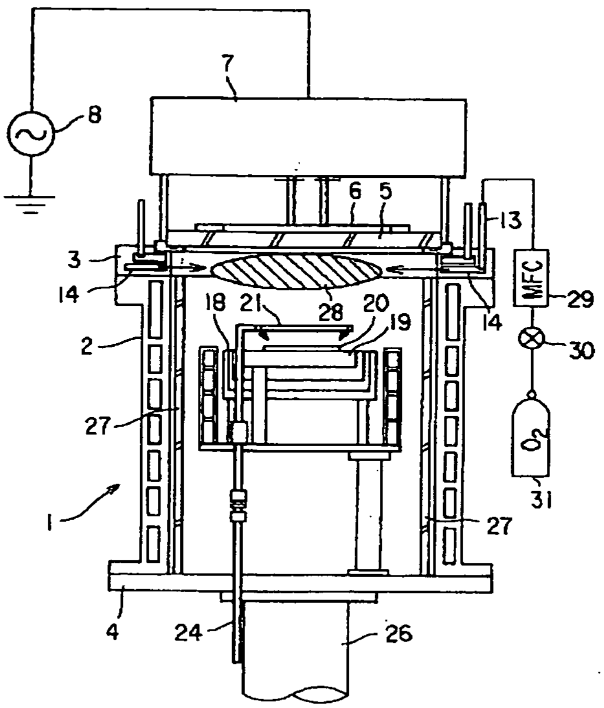
[Translation done.]

DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]